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Good afternoon. Today I will first describe the drivers for improving environmental performance in the electronics industry. I will then briefly talk about industrial road maps, road maps that industry uses to improve their performance. I will then talk about R&D activities at Motorola and also in the electronics industry that I believe point the direction to the future, give our vision of the future, and then draw conclusions.

Environmental performance drivers start with societal concerns (i.e., sustainability, global warming, pollution). These concerns are addressed by several responses. The one that you are most familiar with is public policy. You are very familiar that we have global conventions. We have regulations in various regions of the world. We even have regulations within states or very small regions. In addition to public policy, consumer action is becoming an increasingly important driver. Consumers have indicated that they are willing to pay up to 10% more to have an environmentally preferred product. What is not well understood is, "What does environmentally preferred mean, what characteristics of a product will a consumer pay more money for?" It is apparent that consumers in Europe are more willing to pay a premium than consumers in the United States, but the definition of what attributes are important is still just at the beginning stages.

The Business Value Model, showing the trends towards a sustainable economy, points out many of the issues that are involved. One of the key factors in evaluating the environmental performance of an industrial firm is which group within the firm is dealing with the environmental issues. If the group is the general counsel and public affairs, then clearly there is a fundamental problem in that organization. The next phase beyond the "Right to Operate" phase is when manufacturing and operations become involved, taking on pollution prevention and yield improvement. A further phase is when the Research and Development (R&D) product designers become involved. The ultimate phase is when environmental performance becomes a strategic part of the business.

If I were to position firms from various regions on the Business Value Model, many American electronic firms are moving into the third phase focused on customer loyalty, where the environmental design of the product is becoming increasingly important. We find in general, our European colleagues are much

more in tune to this issue, and are much more involved in designing for the environment, designing for the needs of the marketplace. In Japan, because of the burst of the economic bubble and resulting economic downturn, there has been significant effort to increase market share and to open new markets. Several leading Japanese firms are very pro-active in developing markets based on environmental attributes.

Having shown that there are regional differences, I want to comment a bit more on these regional differences. When I speak about regions, it is not the regions of the U.S. EPA. The regions are North America, Europe and Japan. Global firms want to have global product designs, not regional solutions.

If we look at the United States historically, our environmental activities have been driven by regulation. They have focused, as we have seen, on the factory, on emissions from the factory. Consequently, R&D in the United States has focused very much on the factory--eliminating CFCs, reducing the emissions of VOCs, improving water quality, these types of issues.

In contrast, in Europe customers are involved and concerned about the products they purchase. The regulations tend to focus, not on the manufacturing environment, but rather on products -you have regulations dealing with specifications of products. The R&D in Europe has focused on issues like Design for the Environment (DfE), life cycle analysis, and the material flow analyses that Eric mentioned previously.

If we look at Japan, government agencies and industry have worked together. Their work over the last five years has focused on how can we increase our market share, what can we do to create new market? The R&D has focused on developing new products that will increase market share, such as the hybrid engines, halogen free printed circuit boards, and lead (Pb) free products.

If we look at all this work though, especially in the electronics industry, I think that firms from the three major regions, would all agree on the attributes that we believe are desired in our products. Our products at the end of their life should be highly recyclable; use non-hazardous materials, minimize the use of energy throughout the life cycle (extraction phase, manufacturing phase, use phase)' and they should minimize the use of matter. Minimizing the use of matter minimizes the impact of the extraction phase and minimizes total material flows. I will not talk about minimizing the use of matter through the remainder of this talk,

because in Motorola's culture making our products smaller and lighter is the keystone of our success in the marketplace. Therefore, dematerialization is a given for us. Unlike other industries where automobiles do not become smaller every year, our products become smaller every year. It is one of our keystones that we always focus on this issue, not just for environmental reasons.

What I have tried to do (with the chart: Summary of Drivers by Attribute) is capture the attributes that I have described earlier - in this particular case using the Motorola version of these attributes - and correlate them with the three major drivers - the consumer, government regulations, and business to business interactions.

As I mentioned earlier, we have seen that there are many environmental attributes that the consumer has a difficult time understanding. The concept of recyclability and what happens to a product at the end of life is very difficult for most consumers to understand. However, increasing the recycle content is easy to understand. The consumer can become very concerned about hazardous materials. Whether scientific support for those concerns is justified or not, he can become very concerned. As I note here, typically after that concern is expressed, regulations follow very quickly. Consumers are concerned about reducing energy use.

The message I want to share is that we see a new driver, and that is businesses are concerned about the products that they receive from their suppliers, and they are concerned about the products that they are putting into the marketplace. Therefore, for global businesses, the important driving force is the relationship from business to business.

In this figure, I have outlined industrial structure. Eric talked a great deal about the top line of that structure-the extractive industries, such as steel, energy, and chemicals. There is a general flow in this model going from the extractive industries down to products and to services. Typically, there are often large global firms at the top level. There are large global firms at the bottom level producing products and services. In between there may be various sizes of firms and regional firms. The business-to-business drivers that I have mentioned tend to be from the component phase to the product phase and do not filter back into those larger firms at the earlier stages of the structure.

A number of the extractive and primary industries, through the aid and support of

the Department of Energy, in fact the nine industries that produce 80% of our waste and use 80% of our energy, have been involved in establishing road maps of their activities. The one that I am most familiar with and will briefly mention here is the aluminum industry. They have established a road map, which allowed all of the aluminum firms to compare their performance against their competition and to compare their individual factories to see where their issues and problems were. From this data, they were able to develop a road map to plan for improving their performance.

In the electronics industry, we do very much the same thing. The National Electronics Manufacturing Initiative has a road map which is just being updated, where we identify environmental issues that need to be addressed, and set time schedules and road maps so that the entire supporting infrastructure knows the changes that we are focusing on, and the changes that we plan to make over the next ten years.

I would like to change subjects, and talk about different types of R&D activities that we are doing within Motorola. The first area is Design for the Environment (DfE). With DfE, you look at the areas within a firm that you can control and that you can improve. One of the key activities that we focus on is designing for end of life to increase the recyclability of our products. We analyze all of the materials in our products and how our products are assembled, and how at end of life we would disassemble our products. For each of those pieces that you disassemble, what potentially hazardous materials or valuable materials are contained? We work to optimize the design before we ever sell the product: we look at how that product is put together, so that we can increase the recyclability at the end of life.

Another area of R&D is input-output studies of industries. A good example of input-output studies is the aluminum industry; they performed input-output studies for various plants and alternative methods of producing aluminum. From these study results, they are now working to improve the performance of their industry.

An R&D area that we have recently started exploring is what we call "life cycle assessment along the supply chain." In DfE, we are largely focusing on our own firm and optimizing the environmental situation for our firm. However, if we perform a joint analysis with either our suppliers or our customers, we have the potential of not only improving our impact on the environment, but also

increasing our sales by jointly creating environmentally preferred products that lead to increased sales and profits.

I am going to briefly discuss one study that was done between Motorola and a large cellular service provider in Europe. In that study, we looked at the life cycle of the entire product. We focused on several aspects. One of those was energy. As you might expect, one of the major uses of energy is in the extraction phase, which points out the desirability for recyclability of the materials wherever possible. We found that the manufacturing phase was not energy intensive. The area that was energy intensive was the use phase, in particular the battery chargers that everyone leaves plugged-in at home even when they are doing absolutely nothing. German researchers have calculated that, for Germany alone, five nuclear stations are required to provide the standby power for transformers for electronic equipment. Thus, improving the efficiency of battery charges would significantly reduce energy use.

Based on the results of this study, we addressed several of the issues and built a prototype product, which we jointly demonstrated with our customer. This product focused on several aspects. One was the energy issue. The prototype has a power supply that significantly reduced the energy consumed when it was in standby mode. The other item we looked at was eliminating several hazardous materials. The last thing we did was that we used recyclable plastics in the product. Interestingly as I have said earlier, the concept of hazardous materials was generally understood by the public, but we found that particular hazardous materials were not as well understood. Out of this work with our customer we hope to be able to market a product that has both significantly improved environmental impact, but also increases our market share.

We think that we can move beyond this. We are now engaged in a major research program in the area of life cycle assessment of services. This study is looking at whether we can create a service—a product and a service—where the net impact on the environment is actually positive. This situation is where we displace activities that are negative to the environment, where our entire manufacturing and extraction phase impacts are completely wiped out because of other positive environmental benefits. One good target is to reduce energy used in transportation through wireless based services.

I would like to come back and briefly show you the industrial structure that I showed before. What to illustrate is where industry has done successful proactive R&D. As I pointed out, within a firm one can do DfE. However, DfE only

improves what we do in our firm. A second area is input-output studies that allow an industry to look at how it is performing, and for the industry to improve in general. I think it is fair to say today that our knowledge is such that these types of studies cannot be used to compare one industry to another. There are too many uncertainties, and so that is not a good approach at this time. But as I have noted, supply chain LCA (life cycle assessment) up and down the vertical chain can develop unique solutions that are good for the environment, and we believe will also be good for profitability.

Our vision is that in our products and services we will have the following characteristics: no toxic materials, highly recyclable with no hazardous residue at end of life, energy efficient, will significantly use recyclable materials, and that they would provide services which have a net positive impact on the environment.

In concluding, we think we are on our path to this world, but further R&D and significantly further effort will be required to take us on this journey. Our annual report on our environmental activities in fact is called "A Journey to a Sustainable World." I have placed copies on the back counter if you are interested in that report. You can also have access at the website that I have shown below.

Thank you.